NIKE MISSILE BATTERY PR-79
East Windsor Road, south of State Route 101
Foster
Providence County
Rhode Island

HAER NO. RI-37

HAER
RI
4-FOST,
1-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
Northeast Region
U.S. Custom House
200 Chestnut Street
Philadelphia, PA 19106

HAER
RI
4-FOST,
1-

HISTORIC AMERICAN ENGINEERING RECORD

NIKE MISSILE BATTERY PR-79 HAER No. RI-37

Location:	NIKE Missile Battery PR-79 is located in two locations and connected by State Route 101. The Launch Area is on East Windsor Road and the Control Area is on Tucker Hollow Road. Both are in the town of Foster, Providence County, Rhode Island.

UTM:	Launch:	Control:
	19/273140/4635700	19/274580/4635760
	19/273260/4635350	19/274620/4635690
	19/273120/4635300	19/274530/4635640
	19/273020/4635690	19/274550/4635580
		19/274470/4635490
		19/274410/4635740

USGS Quadrangle:	Clayville, RI
Date of Construction:	1955
Engineer:	United States Army Corps of Engineers with Contractors
Architect:	United States Army Corps of Engineers with Contractors
Present Owner:	Launch Site, Rhode Island State Police Control Site, Town of Foster School District
Present Use:	Launch Site, Rhode Island State Police Training Academy Control Site, office space, recreational space
Significance:	The Foster NIKE Missile Battery PR-79 is significant because it is a representative example of NIKE batteries in New England and in Rhode Island. PR-79 is an intact, physical manifestation of American military history, and in particular, the Cold War in the United States and as such, it demonstrates the technology and prevailing political attitudes of the 1950s.
Project Information:	This mitigative documentation was undertaken in 1993 in accordance with Stipulation IV(A)(2) of the Programmatic Agreement for portions of the Defense Environmental Restoration Program (DERP), executed by the U. S. Army Corps of Engineers, New England Division. Jane Carolan, Architectural Historian and Project Manager; Martin Stupich, Photographer; Barbara Putnam and Joyce Clements, Researchers; with Timelines, Inc. Submitted to: ENSR Consulting and Engineering, for the U. S. Army Corps of Engineers, New England Division.

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INTRODUCTION

The NIKE system, first developed in the 1950s, was the United States' first and most widely deployed air defense missile system. NIKE installations were a critical element in national air defense during the Cold War. While the U.S. military deployed a number of air defense systems during and after the Cold War, NIKE was the most accessible to the public because of its numerous installations in close proximity to major metropolitan areas.

NIKE Battery PR-79, in Foster, Rhode Island, is one of the best-preserved NIKE installations in New England. During decommissioning, missiles, fueling and guidance systems were removed but the remaining buildings provide a rich level of interpretative material. The Foster site typifies the NIKE system in its technical, operational and architectural elements and is a physical manifestation of American military history and of our nation's involvement in the Cold War.

UNITED STATES AIR DEFENSE

United States Air Defense

The development of rocket technology, according to Gatland, can be traced to the Chinese in AD 1232. It was during this time that Chinese townspeople used "fire arrows" against Mongol hordes. These arrows have been described as "making a noise like thunder and travelling a great distance." [1] Rockets were used throughout the following centuries as fire works and weapons, but development of the modern rocket, using liquid propellants, was not to come until the early twentieth century. Using technology developed in Russia, the first flight of a liquid fuel rocket took place in Auburn, Massachusetts on 16 March 1926. The work in Russia was carried out by Konstantin E. Tsiolkovsky and in the United States by Robert H. Goddard. [2] But it was only during World War II that the technology and concept of using rockets and missiles in warfare was firmly established. Much of this pioneering work was done by the Germans, who were the first to use missiles guided by radio transmissions. [3]

Also during World War II, the United States military began to experiment with missiles and rockets. In 1943, the United States Army established the Rocket Branch within its Ordnance Corps and in 1945 assembled Bell Laboratories and the Western Electric Company into the team that would eventually develop the NIKE program. [4]

The "Cold War" era greatly accelerated missile and rocket technology and it was then that NIKE missiles were deployed. Used to describe hostile relations between communist and non-communist countries, the term "Cold War" came into use shortly after World War II. The term originated because most of the actions of the opposing groups fell just short of those that exist during a "hot," or shooting war. The "Cold War" crystallized around the adversarial relationship between the United States and the Soviet Union.
Although there was no actual fighting, the countries involved in the "Cold War" developed

extensive armaments and states of preparedness for the eventuality of an armed conflict. Perhaps the most frightening aspect of "Cold War" munitions was the development of atomic and nuclear weapons. Although developed before the Cold War, their threat was heavily exploited during this period. In 1953, both the United States and the Soviet Union tested hydrogen bombs [5].

The U.S. involvment in the Korean War escalated its anti-aircraft research. The goal of the Army in the 1950s was to establish a nationwide defense system to protect against Soviet intercontinental ballistic missiles. The earliest of these defense systems was the NIKE air defense system, a system of underground surface-to-air guided missiles (SAMs) placed in critical positions around major urban centers within the continental United States, Hawaii and Europe. The installations were also placed near strategic military installations such as air force bases or arsenals. The NIKE Ajax, an air-defense missile designed to attack incoming airplanes or missiles, used conventional warheads and was the first technological advance in the conversion of the U.S. air-defense system from artillery to guided missiles. [6]

Because the NIKE system was so extensive and so widely used (at one point there were over 3,000 launchers in service), the next-generation missile, the Hercules, was designed to fit into the existing system. The Hercules, a bigger, more powerful missile with a longer range, was capable of using nuclear warheads as well as conventional warheads. It was first deployed in 1959, and by 1960 most Ajax rockets had been replaced by the Hercules. The final phase in the NIKE program was the NIKE Zeus missile. Development began in 1958 with a finished version of the rocket completed in 1964. [7] It had a more sophisticated radar system than the Ajax and Hercules. Although the Zeus was never activated, many of the systems developed in its research were used in later, antitactical ballistic missile (ATBM) systems. [8]

Nike was the first and only system built on such an extensive basis and used to defend major cities, strategic locations and specific population targets. After 1960, advanced technology in ballistic-missile defense (BMD) made the NIKE system obsolete, although it was not completely decommissioned until 1974.

In 1959, a surface-to-air weapon, the Bomarc, was developed by the Air Force. It was a pilotless intercepter, used for defending wide areas, and could be launched from large shelters with sliding roofs. It used either a conventional or a nuclear warhead. [9] As with many "Cold War" defenses, Bomarc was continually being revised, necessitating constant modification of launching shelters. "Among the most hastily constructed project[s], the Bomarcs were also among the most ephemeral of Cold War installations. They were hardly completed, when like the Nike batteries, they were made obsolete by Intercontinental Ballistic Missiles (ICBM's)."[10]

Further limiting the use of the NIKE system was the development of ICBMs, which are capable of a range of 3,500 to 10,000 miles. Because of their extensive range it is not necessary for them to surround the area they are protecting, as with NIKE, and launch sites are picked for trajectory range and security. In 1957, as part of this ICBM program, the Air Force deployed its first intercontinental ballistic missile complex at F.E. Warren Air Force Base in Wyoming. [11] Between 1958 and 1962, the Minuteman "B" missile, a three-stage solid-fuel rocket, was deployed in silos throughout the United States that were similar to those developed at F.E. Warren. In 1973, these were replaced with Minuteman III missiles, all of which were ICBMs. [12]

The Cuban Missile Crisis of 1962, caused by Soviet construction of missile installations in Cuba, resulted in the Nuclear Test Ban Treaty of 1963. This was signed by the U.S., the U.S.S.R and Great Britain. Despite the test ban, research, development and deployment of a great number of weapons continued throughout the world.

By 1965, the army had developed another intercepter, the Spartan, which could detonate a nuclear warhead above the atmosphere, generating intense X-rays capable of knocking out several incoming missiles. The public outcry against this system was so great, however, that it was scrapped. [13]

In addition to the missiles described above, the Army was, during the 1950s and 1960s, developing a number of other missiles as well, some of which are still in use today. Among these are the Hawk (Homing All-the-Way-Kill), first developed in 1954 and operational in 1959. The Hawk is one of the most widely deployed missiles today, being a truck mounted missile and therefore extremely portable. [14] The Chaparral, which can be launched from a tracked amphibious vehicle, was first manufactured in 1965 and was used through the 1970s. The Stinger missile was developed in the late 1960s-early 1970s, and is a hand-held rocket that weighs only 22 pounds, with a launcher that weighs only 30 pounds. This weapon, which has a range of three miles, is used by infantrymen. [15]

In 1972, the Strategic Arms Limitations Treaty (SALT) limited the production of nuclear weapons as well as restricting the deployment of Anti-Ballistic Missiles. [16] The treaty was renegotiated in 1979, but the United States refused to sign it. [17] Production of arms continued. Today the most widely produced missile is the Patriot, which received major press coverage during the 1990 Gulf War. The Patriot was being developed as early as 1961 and was intended to replace the NIKE system, but was not deployed until 1974. It is fired from mobile truck units and is capable of engaging multiple targets, using either conventional fragmentation warheads or nuclear warbeads. [18]

In 1983, a new missile defense system, the Strategic Defense Initiative, commonly called Star Wars, involved the development of ground- and space-based weapons designed for the destruction of enemy warheads from space. [19]

Today, with the end of the "Cold War," the nuclear arms race has slowed considerably and the Star Wars system, the last of the defensive programs developed, is currently undergoing modification and may never achieve actual deployment.

Army Air Command Organization

This section and the two following sections (NIKE Command and NIKE Battalion Organization) draw heavily on Historical Overview of the Nike Missile System, by McMaster et al., published in 1983.

The development of a missile-based air defense system necessitated the reorganization of the Army command structure. In 1950, all artillery units were joined to a new continental air defense system under the U.S. Army Antiaircraft Command (ARAACOM) based in Colorado Springs, Colorado.

The construction of NIKE bases throughout the continental United States and overseas during the years 1953 through 1955 led to a further restructuring, and in 1954 ARAACOM and corresponding units in the U.S. Air Force and U.S. Navy were combined to form the Continental Air Defense Command (CONAD) at Colorado Springs under the direction of the Joint Chiefs of Staff. In 1957, the reorganization was further refined by determining that the Army's air defense had a responsibility within the continental United States for

> point air defense by missiles fired from the ground to aerial targets not more than 161 kilometers (km) away. Point defense was to include 'geographical areas, cities, and vital installations that could be defended by missile units which received their guidance information from radars near the launching site' and also was to include responsibility of a ground commander for air protection of his forces. [20]

Determining the exact number of defense locality commands existing at any given time is difficult due to conflicting information in Army accounts, but according to McMasters et al., there were approximately 100 commands in the continental United States. The Army's missile mission was renamed U.S. Army Air Defense Command (ARADCOM). In the same year, the United States and Canada established a combined air defense under the North American Air Defense Command (NORAD). All Army ARADCOM units were thus placed under NORAD and NORAD commanders reported directly to the Joint Chiefs of Staff.

NIKE Command

The NIKE system was initially under the command of the Office of the Ordnance Corp (OCO). In 1951, portions of control, including monitoring, coordinating, and technical sections, particularly contractor/government coordination, were transferred to Redstone Arsenal. The OCO retained responsibility for direction and decision making on policy, scope, goals and significant modifications to missile design, performance and operation.

In 1958, the U.S. Army Ordnance Missile Command (AOMC) was established at Redstone Arsenal. Divisions under AOMC included the U.S. Army Rocket and Guided Missile Agency

(ARGMA), the U.S. Army Ballistic Missile Agency (ABMA), the Jet Propulsion Laboratory, White Sands Proving Grounds, and Redstone Arsenal. Under the command of AOMC, ARGMA developed the Hercules systems and the conversion of Ajax sites to Hercules sites. [21]

In 1961, with the introduction of ballistic missiles, ARGMA and ABMA were disbanded and two new groups formed under AOMC, one for ballistic missiles and the other for guided missiles, which included the NIKE program. In 1962, the army established two new commands, the U.S. Army Materiel Command (AMC), which replaced OCO, and the U.S. Army Missile Command (MICOM) which eventually replaced AOMC. MICOM commanded the Hercules program until 1971 when it was turned over to Air Defense Special Items Management Office (ADSIMO), which was part of MICOM. [22]

NIKE Battalion Organization

The individual operational units of the NIKE system were composed of a fire unit, or launching section, which contained a control station and four launchers. Three firing units made up a battery, four batteries formed a battalion. Each battalion contained a headquarters and headquarters battery, four firing batteries and a medical section. Approximately 400 personnel were needed to operate each battalion. The majority of personnel were untrained in technical services but were necessary to the functioning of the installations. These men worked as sentries, provided maintenance of the grounds and buildings, worked in the mess hall and kitchens, and in offices, mail rooms and supply rooms. Technical specialists were responsible for manning radar units, missile maintenance, and launch activities.

The following quotation from McMaster et al. details the personnel breakdown of each battery.

> A missile battery was composed of six elements. These are listed below, followed by brief mission statements:
>
> 1. Headquarters Section: The responsibility of the headquarters section was essentially the operational and administrative control of personnel and equipment.
> 2. Communications Section: This section was responsible for installing and maintaining noncommercial communication nets and operating the commercial communication nets within the battery.
>
> 3. Fire Control Platoon: The fire control platoon was responsible for the operation and maintenance of the fire control equipment in the battery control area.

4. Launching Platoon: The launching platoon consisted of one launching platoon headquarters and three launching sections.
5. Launching Platoon Headquarters: The launching platoon headquarters which was responsible for the operation and training of the three launching sections, contained personnel who assembled, tested, and performed organizational maintenance on the Nike missile and maintained the rounds at the launching section.
6. Launching Section: The three launching sections were responsible for the preparation of the missile and booster for firing after they were delivered to the launching section from the assembly and test area. In addition, they performed routine nontechnical tests, checks, adjustments, and organizational maintenance. [23]

Army National Guard

The NIKE batteries were manned by the regular Army until the conversion of the sites to Hercules missiles in the late 1950s. At that time, the Army National Guard (ANG) took command of the sites. Many of the troops that would be activated had been in the Korean War and released during 1952 and 1953. Between 1953 and 1957 the U.S. Army and Air Force, working together, undertook a study "to make more efficient use of our inactive National Guard anti-aircraft artillery [forces]."[24] The study developed a system to man the newly constructed NIKE missile sites using National Guard forces. Because the NIKE sites were constructed so quickly, the Army was having difficulty providing enough trained personnel. Using the ANG helped supply the necessary manpower. [25]

Deploying Guard units to NIKE sites in 1958 resulted in an arrangement that would last for over twenty years and give the Guard a specialized mission in the U.S. By 1961, ANG were stationed at 82 batteries within the continental U.S. (CONUS) and 6 in Hawaii. [26] By 1962, 17,000 Guardsmen were in the NIKE program, 4,936 of them trained technicians. The ANG remained operational until the NIKE program was phased out in the mid-1970s. [27]

CONSTRUCTION OF NIKE SITES

The Army Corps of Engineers

The Army Corps of Engineers (COE) is the planning, engineering and construction arm of the United States Army and was founded in 1802, along with the Army Engineering College at West Point, New York. The COE was originally tasked to design and build fortifications, roads and bridges while the Quartermaster Corps (QC) built any facility that was used for sheltering and supplying the Army. However, this separation began to be questioned during World War I when the sheer scale of the war and need for rapid mobilization of thousands of personnel overwhelmed the QC. To meet this demand, a separate construction division of the QC was established. [28]

Little building or maintenance took place after World War I, and many facilities were in disrepair when the 1939 mobilization began for World War II. Again, the Construction Division of the QC was unable to keep up with the demand and in 1940, all defense and, in particular, all Army and Air Force construction was transferred to the COE. The following year, all "Army construction, and responsibility for maintenance and real estate as well, [was placed] under the Corps of Engineers." [29]

The New England Division of the COE took on the first project to be transferred from the QC to the Corps, the construction of Grenier Air Force Field in Manchester, NH. During the 1940s, the COE built many of the major Air Force fields in the United States, paying particular attention to a "comprehensive program of camouflage and concealment." [30] This was achieved by designing air fields to fit into their surroundings, via careful building placement and landscaping, and by cutting the minimum amount of vegetation. After World War II ended, the COE spent much of its time honoring its peacetime commitment to navigation improvement and flood control. [31]

The Cold War, and particularly the North Korean attack across the 38th Parallel, had an enormous impact on the COE, as it did on the entire Armed Forces, and it resulted in the COE's undertaking a massive building campaign to ensure U. S. air defense readiness. The earliest of these defense systems was the NIKE.

As early as 1952, the COE began meeting with the Ordnance Corps to begin development of initial design concepts for the NIKE Program. In addition to planning and construction of these sites, the COE was charged with real estate acquisition. [32]

After planning and design, the next task of the COE was land acquisition. Acquiring sites for this global program was not an easy task since hundreds of sites would be required to be built throughout the United States and Europe. As originally conceived, the NIKE program was an aboveground system of mobile defense, moved from place to place with extensive earth moving and berm construction and land requirements for each site as great as 104 acres. [33] As described in a history of the start-up of NIKE:

> The big impact of attempting to use a field weapon in the United States was on real estate acquisition and quickly it became apparent to everyone that something had to be done to reduce the number of acres required for emplacement. [34]

The COE felt that locating missiles underground would improve maintenance and preservation of equipment, greatly increase protection from sabotage, and lessen the impact on the public since the missiles could not be seen. [35]

The NIKE installations were usually placed in a ringed formation around the city or site they were protecting. Because protection was of paramount importance, a ringed defense would sometimes overlap state lines in order to adequately defend a potential target. For instance, the Providence Defense Area had five installations in Rhode Island, and two in Massachusetts to provide adequate coverage. The continental United States was divided into Defense Areas, such as the Washington-Baltimore Defense, the Providence Defense and the Los Angeles Defense areas. The first combat-ready site was built at Fort Meade, Maryland, part of the Washington-Baltimore Defense Area. [36]

The criteria for site selection, as of 1954, dictated that sites "must satisfy the tactical requirements of the appropriate AAA (Anti-Aircraft Artillery) Commander", who was the commander for each defense area. [37] Site locations were also based on lessening the impact on the public. When determining locations, priority was to be given to placing an installation on an existing Army post. If that was not possible, then other government-owned land would be acquired. If that was not feasible, then land owned by government entities such as states, counties or cities would be acquired, and as a last resort, privately owned land would be procured by purchase or condemnation. [38]

In addition to requirements for individual batteries, the installations, organized into battalions of four batteries each, were subject to geographic restrictions that required them to be located within a predetermined distance of each other and of the target they were protecting. Each installation required a Launch Area, where the missiles were stored and launched, and a Control Area, where all radar equipment was located. Some installations had separate housing for families of married officers.

A typical launch site required about 45 acres in a roughly rectangular shape. Fifteen acres would be developed; the other 30 acres held in reserve for an additional battery of missiles and launchers, and to provide safety space between living quarters, the missile preparation area and the actual launch site. Most important, the Launch Area needed to be within 1,000 to 6,000 feet from the Missile Tracking Radar at the Control Area because of the range of the radar and the practical problem of laying the cable required to link the two areas. [39]

The Control Area needed to be roughly rectangular or L-shaped and approximately 6 to 8 acres. [40] Control sites needed to be located away from radio interference.

> Radio interference to be expected from certain nearby electrical installations would be sufficient to eliminate from further consideration sites otherwise satisfactory. [41]

In addition, as described above, the Control Area needed to be radar-accessible to the Launch Area, and at such an elevation as to avoid the effects of "tree mask" for the three radar components required. During a launch, when the missile was in an erect position, it was vital that the antenna of the missile be on a line-of-sight to the Missile Tracking Radar at the control site. [42]

Both areas needed to be relatively flat, open and well drained. Additional land was needed for restrictive easements to prevent access to the sites and for fire breaks, as well as for line-of-site links between control and launch installations and cable laying.

An additional 4 or 5 acres were also needed at whatever Launch or Control Area would be designated battalion headquarters. Housing facilities, if necessary for married officers' families, were to be not over 500 yards from the entrance to the site being served. All basic electrical service would be obtained from the commercial grid. Sites needed to be located on or near all-weather public paved roads, since these would be consistently maintained. [43] The COE summed up the criteria as follows:

> Each battery location will pose a separate and distinct problem of fitting the standard battery equipment into the terrain. In working out siting problems, it will be impractical to modify Special AAA equipments to satisfy individual or local situations. Therefore, it is necessary to find workable solutions based upon the criteria contained herein. [44]

Standardization and Typical Site Requirements

The Army, along with other military branches, has a long tradition of standardization: of uniforms, of hierarchy, and of construction. Standardization provides general uniformity for posts throughout the country. Furthermore, "From the Army's point of view, such standardization of design, detail, and finish promoted construction efficiency and cost economy." [45] Research in the Corps' NIKE archives substantiates this observation. While variations exist for each site, mostly due to the strict demands of site location, overall the type of construction, materials and general layout are comparable.

A review of drawings available at the COE office in Waltham, MA, identified the architects and engineers involved in initial design. All NIKE facilities throughout the United States, Europe and territories were designed by Leon Chatelain, Jr., an architect of Washington, DC, together with Spector and Montgomery, Architects, a firm located in Falls Church, VA. Plans were then disseminated to defense areas where local architects and engineers prepared individual sites and customized designs to site-specific conditions.

Leon Chatelain, Jr. (1902-1979), a native of Washington, DC, started his architectural career in 1930 when he began designing for the Chesapeake and Potomac Telephone Company, a client with whom he would be associated for 45 years. During Mr. Chatelain's long career, he worked for Georgetown University, the federal government, and the Smithsonian Institution. He designed a number of churches, private-school buildings, office buildings and private residences.

In addition to his architectural work, Mr. Chatelain was an active participant in the local Washington, DC, business community, was Chairman of the President's Committee for the

Employment of the Handicapped under the Johnson administration, and was President of the American Institute of Architects from 1956-1957.

His son, Leon Chatelain, III, also an architect, entered the family practice in 1971 and became a partner in 1973. During the 1970s the firm split into three separate enterprises. Today, Leon Chatelain, III, runs his own architectural firm under his name and maintains his father's drawings and records. The elder Mr. Chatelain retired in 1975 and died in 1979.[46]

To date, no documentation has been found relating to the history of Spector and Montgomery.

In 1953, Chatelain designed and produced drawings for the Underground Missile Storage Structure - Type "B" and Mess Halls. In 1954, the firm designed the Missile Assembly and Test Building, Acid Storage Shed, Acid Fueling Station, and Generator Building for the Launch Area, and produced drawings for the Underground Missile Storage Structure - Type "C".

The same year, Spector and Montgomery, designed the Enlisted Men's Barracks and Officers' Quarters. In 1955, Spector and Montgomery designed the Interconnecting Corridor and, in 1959, additional facilities for Missile Storage Structure - Type "C".

NIKE sites were built under Modified Emergency Construction (MEC) guidelines, which specified masonry for exterior walls. Emergency construction was generally of the prefabricated wood-frame type. MEC materials called for concrete slab on grade floors with integrated concrete column footings, concrete block walls with no interior finishes, wood-frame 2/2 horizontal muntined windows, interior columns and beams made up of built-up standard sized lumber, and wood roof construction.

To boost troop morale, a higher grade of modified emergency living and working quarters was constructed throughout the NIKE installations. Interior wall partitions were masonry and concrete floors were covered with asphalt tile. "This [asphalt-tile flooring] is not authorized under modified emergency construction. This was introduced solely to provide a more livable structure and required special authorization from Staff, ..." [47]

By late 1953, final design of the Underground Missile Storage Structure was completed. In reality, these drawings were just the beginning of many "final" designs for every component of the site:

> It was thought at that time [1953 final drawings] the job was finished and military construction personnel could turn to other things, yet it is of interest that the job is not yet finished as of this date, ...<u>The reason the job is not finished is that the Missile Program is one of constant change</u> [author's emphasis]. Beginning with the missile and the associated hardware, improvements are being made constantly, and these changes, of course, must

> find reflection in the fixed installations that accommodate them to insure compatibility. Further the conceptions of usage change. The requirement of the Using Service change, ranging all the way from one of complete austerity, using prefabricated structures to one where justifications of permanent standards of construction are attempted. These fluctuate with the passage of time, and as new military personnel are assigned; new people generate new ideas. Other factors become important from time to time and sometimes disappear. [48]

The above section of the report was written in 1952; in 1957, another section of the document stated:

> Even today after five years experience with the program, the drawings cannot be considered in final form. There has never been a period wherein accommodation to changing technical criteria, or changing user or staff requirements has not been necessary. ...in some cases it has been possible to anticipate the not yet authorized changes thus preventing obsolescence. [49]

Construction changes also came through experience. In 1955, it was decided that pilasters were not required in exterior walls of the Enlisted Men's Barracks if a cross partition was added in the middle of the building. This was "suggested by South Pacific Division." [50]

This situation, not uncommon for the military or with rapidly changing technology, resulted in a NIKE program that ultimately devised "final" plans for individual components (i.e. missile silos and storage) that could be modified as required.

By 1955, the COE began construction of NIKE sites with the directive that, "Typical site layouts are schematic and will be used as guides in preparing site plans adapted to topography and local condition." [51]

The standard NIKE site could contain the following structures:

Launch Area

- Underground missile storage structures (2 or 3)
- Missile assembly and test building
- Generator building
- Acid storage shed
- Acid fueling station with earth mound
- Enlisted men's barracks and officers' quarters
- Pump house - water; water tank if required
- Paint and oil storage
- Sentry box
- Water supply, electrical distributors and sewage disposal systems
- Security fencing

Improvements that have been authorized are:
- Paved roads, hardstands and parking areas
- Sidewalks
- Four NCO rooms in barracks
- Street lighting in housing area
- Flag pole
- Combination athletic court
- Ready building where required to maintain a ten minute alert status
- Generator building of masonry construction with operators shed (these were originally designed using sheet metal construction)
- Medical aid room added to missile assembly and test building
- Classroom and theater building (in launching or control area)
- 1,000 gal. underground fuel oil storage tank
- Miscellaneous improvements in underground missile storage structure
- Additional pad at the fueling area

Control Area
- Radar pads or towers if required
- Mess hall
- Enlisted Men's Barracks and Officers' Quarters
- Administration, recreation and storage building
- Security fencing
- Pump house - water; water tank if required
- Water supply, electrical distribution and sewage disposal systems

Improvements that have been authorized:
- Interconnecting corridor
- Generator building with 1000 gal underground storage tank (corridor and generator have been added to permit omission of spare parts trailer)
- Sentry box
- Flag pole
- Paint and storage shed
- Combination athletic court
- Paving of roads, hardstands and parking areas
- Sidewalks
- Four NCO rooms in barracks
- Street lighting in housing area

(Note, this list is taken from a document written in ca. 1957, which accounts for the appearance of some items as change orders.)[52]

Again, as noted above and confirmed by COE documents, typical facilities were modified throughout their entire existence through change orders, updated technical manuals, and internal memos and directives. A 14-page list of improvements for NIKE installations, compiled in 1957, listed such changes as "added entrance and vestibule to mess hall; toilet facilities added in Missile Assembly and Test Building replacing an outdoor Pit Latrine; added coffee table and coffee maker to Missile Assembly and Test Building; added NCO rooms in EM barracks; added hydraulic-mechanical system as an alternate to the pneumatic system previously provided."[53]

Because of the rapid construction requirements, some of the work was hired out to private contractors while other tasks were completed by troops. A 1954 memo suggests that the contractors would be responsible for installation of utility systems and government-furnished equipment, as well as construction of all roads and buildings, including the removal of any obstructions to construction. Troops were responsible for clean-up work after construction, clearing and topping of trees to obtain lines-of-sight and eliminate "tree mask," fencing, landscaping, and erection of any prefabricated structures. [54]

Construction of "on-site facilities for Surface-to-Air Missile Battalions" had priority over all other Army construction with the exception of manufacturing ammunition. To expedite construction, the Army issued contracts on a separate project basis. [55]

Initial site work consisted of removal of vegetation and existing structures and contouring work, with considerable concern for camouflage because of the sensitive nature of the installations.

> While the characteristics of these installations and their requirements for efficient operation makes [sic] concealment of NIKE sites extremely difficult, any practical means of making them inconspicuous from above should be considered. Measures that might help included protecting, with a view of preserving, existing trees and other vegetation ..., careful fitting of construction to topography to avoid grading scars; and removing construction scars by appropriate planting, or otherwise harmonizing the developed areas with their surroundings. [56]

Installation plans strongly urged, on the basis of practical considerations, that buildings should be grouped together for "easy administrative control" and near the entrance to the site. Structures needed to be a minimum of 40 feet apart for fire safety, and 30 feet from the site boundary for security. The fueling station needed to be at least 140 feet from the missile storage facilities, and housing and administrative structures needed to be located away from these areas and upwind. [57]

The recommended scheme of Launch Areas resulted in a three-part arrangement whereby the area closest to the main access gate contained barracks, mess halls and administration facilities. The mid section, often separated from the other areas of the site by an earthen berm, contained the Missile Assembly Building, Generator Building and Fueling Station. The last third contained the Underground Storage Structures.

Typical layouts of Control Areas were divided into two sectors with Barracks, Administration Building and Mess Hall grouped together and radar facilities grouped together on the highest elevation available and separated from the other structures.

While NIKE installations were built for Ajax missiles, they were easily converted to Hercules since these rockets were designed with conversion and reuse in mind. Because they could carry nuclear weapons, in addition to conventional warheads, a separate Warheading Building was constructed at the Launch Area and fallout shelters were added to both the Launch and Control Areas. Security increased around Hercules sites. Some of the Launch Areas were protected by guard dogs and the "information as to which batteries were armed with atomic warheads and which weren't was never revealed to the public." [58] Because of the Hercules' larger size, underground storage racks and launchers needed to be modified as did the elevators. Decontamination showers were added to all launch sites at the underground storage area.

The final component of the site was family housing built under the Capehart Act. This bill, sponsored by Senator Homer E. Capehart (Republican Senator from Indiana, 1945-1963) authorized private contractors to build military family housing with private financing insured by the Federal Housing Administration (FHA). Once built, the housing was operated and amortized by the military with funds appropriated by Congress. The Capehart program was authorized in 1955 in Title IV of the 1955 Housing Amendments. It was disbanded in 1962 after a controversy in 1961, when the program was characterized as "scandal-ridden," due to the use of private funds. It was recommended that in the future, military family housing use direct appropriated funding. [59] Housing for military personnel and civilian workers was built by a number of different programs which were used to expand housing at existing bases and provide housing at new bases as military personnel increased in number and since many of the older bases did not have enough housing units. Specifications for Capehart housing dictated that structures were to be built out of wood or masonry and were to be one or two stories, with one, two or three bedrooms. Houses generally had shallow gable roofs and entrances located in the long side wall of the rectangular plan. Houses were to be sheathed in clapboards or vertical board and batten siding, as well as occasional red face brick below the windows. Single family houses, such as those built in Foster, were generally around 2,000 square feet. [60]

The Capehart housing for PR-79 is composed of 16 single-family units, built in a U-shape, connected by a U-shaped street. Houses line both sides of the street. Each unit is a one-story, concrete block, rectangular structure on a concrete slab with a shallow, gabled roof. Windows are 1/1 or single pane. Most of the homes have undergone remodeling and updating and are quite different from one another although the basic, original design is readily apparent. A concrete-block pump house and storage tank, identical to the ones at the Launch and Control areas, were built here and appear to be intact and operational.

Decommissioning

The NIKE sites, planned for a life span of approximately ten years, were decommissioned between 1964 and 1975, expanding their expected lifetime by 9 years. In 1963, there were 164 active Hercules firing batteries; in 1974 that number was reduced to 52, and by 1975 only 4 batteries remained active. [61] Today, some equipment is kept for training at Fort Bliss, TX, but the last operational battery, also at Fort Bliss, was decommissioned in 1983. [62] The sites were dismantled in a carefully orchestrated sequence of 52 steps over a period of six months. Most of the buildings and missile magazines on many sites were left in place and sold as surplus real estate (some of the magazines having been sealed). Missile components and supplies were returned to the depot-supply areas from which they were originally shipped. The launcher area was drained of fuel and hydraulic fluids, as were the acid fueling pits. Missiles were taken apart, put back in their shipping containers, and returned to the arsenals where they had been constructed. Some of the silos have been sealed, their hardware and elevators remain in place and in some cases are operational. [63]

TECHNOLOGY OF NIKE SITES

> On many of the hilltops surrounding the industrial and strategic centers of the United States fenced-in assemblages of whirling radar antennae, small buildings, and olive drab trailers have appeared. Giant white darts may occasionally be seen to rise out of underground chambers nearby and stand side by side with their points elevated skyward. Such an installation is occupied by a battery of an Army antiaircraft missile battalion, a select, highly-trained group of specialists who control a deadly weapon of defense, the Nike. [64]

The NIKE missile system used a guided missile which was directed to its target either by a guidance system in the missile or by radio command from outside the missile. Usually, this type of missile has a trajectory entirely within the earth's atmosphere and is guided along its entire flight. The Ajax's missile (the first of the NIKE system missiles) mission was to "destroy, nullify, or reduce effectiveness of attack by hostile aircraft and missiles after they are airborne." [65]

The Ajax missile was a "2-stage, supersonic missile armed with three large-radius, spherical-burst, high-explosive warheads mounted in the nose, center, and aft sections of the missile." [66] The first stage of the rocket was powered by a solid propellant booster with a single small fin. The second stage was powered by a liquid-fueled sustainer motor with three sets of cross-shaped fins that were for steering, sensing and stability. The Ajax was 21 feet long, 31 feet with its booster rocket attached. It was 12 inches in diameter, weighed 2,300 pounds, had a range of 225 miles and traveled at supersonic speed. [67]

By 1951, the Ajax program, originally called NIKE I, was accelerated, and two years later testing began at the White Sands Proving Grounds in New Mexico as well as at the Redstone

Arsenal in Alabama. In 1954, the first combat-ready NIKE Ajax was deployed at Fort Meade, Maryland. [68]

Even while the Ajax was under development, it was apparent that it had drawbacks. In particular, "the limited resolution of the Ajax target tracking radar ... tended to wander between planes in a formation, resulting in the missile passing between two aircrafts [sic] and detonating without causing damage . . . ." [69] Because of this, feasibility studies were begun in 1952 for the NIKE II, the Hercules missile, which was developed and tested between 1955 and 1959 with initial deployment in 1958.

The Hercules, conceived as an improved air defense system, was capable of "countering anticipated aerial threats and could be modified to keep pace with advances in attack systems." [70] Furthermore, it was capable of carrying conventional and nuclear warheads, which could only be fired with a small detonating device that had to be placed on the missile prior to firing. The Hercules rocket was a "2-stage system, employing a cluster of four Ajax boosters [using] Ajax liquid propellant (later changed to solid propellant) sustainer motors. Stabilization and steerage were accomplished by four fixed fins with trailing-edge control surfaces mounted to the aft of the missile." [71]

Both missiles could be deployed from the same launcher, using similar guidance systems with only slight modifications. The Hercules was designed and built by Western Electric, the Douglas Aircraft Company, the Thiokol Chemical Company, Goodyear and Bell Telephone Laboratories. It was 27 feet in length, 39 feet with its booster, 24 inches in diameter and weighed 10,000 pounds. Its range was 775 miles and it traveled at a speed of 7 Mach 2.5. [72]

The final missile developed for the NIKE program, though never deployed, was the Zeus, which was a 3-stage, solid-propellant missile, equipped with a nuclear warhead. It was, at the time of its development, the most powerfully armed missile available. [73]

<u>How the NIKE System Worked</u>

The Launch Area contained the missiles and warheads, and it was there that missiles were assembled, armed, inspected, maintained, stored and launched. Constructed at arsenals around the country, missiles were shipped by truck, with individual components in specially designed containers in which they were stored until needed. [74] At the Missile Assembly Building, the rockets were put together; fins were attached, electrical systems connected and hydraulic fluids added. [75] From the Assembly Building to the Acid Fueling Area and Launch Magazines, they were manually wheeled on large dollies along concrete walks specifically constructed for the purpose. The missiles were then loaded into the underground magazines.

The typical Launch Area contained three magazines, each containing four rockets with one missile in position and 3 reloads for each launcher. [76] The underground launch facilities contained a storage magazine, an elevator to carry missiles to the surface to be fired, operating panels, and missile storage racks. After assembly, missiles were stored on the racks.

When ready to be fired, they would be rolled to the elevator and onto the elevator launcher.

> Each launcher loader included a launcher and five sections of loading racks. Three sections of racks were on the left side of the launcher and were used for storing missile-booster combinations. The sections on the right side of the launcher were used for storing empty launching and transport rails or rejected rounds. .... The entire unit was equipped with electric and hydraulic systems for testing and erecting the round prior to firing. [77]

The system was designed to have one missile in flight at a time. Average flight time from launch to target was one minute, therefore an entire battery could be launched within one hour. [78]

The missiles had guidance systems within their casings and were launched by remote control from the Control Area with three types of radar. The heart of the launch operation took place in the control and radar trailers that were deployed on concrete pads at both areas. At the launch site, there was a Launching Control Trailer was parked near the silos. This contained:

> the controls, displays, and communications equipment [and personnel] necessary to supervise and monitor the activities of the launching sections during an engagement and to act as a relay station between the launching sections and the battery Control Area. [79]

The Acquisition Radar (ACQR), operated from the Battery Control Trailer, included the acquisition antenna, receiver and transmitter, and initially identified an incoming target and alerted the Control Battery. Target Tracking Radar (TTR) contained a tracking antenna, receiver and transmitter, and was mounted on an antenna trailer. This radar locked onto the target at closer range than ACQR and tracked its movements. Missile Tracking Radar (MTR) was comprised of a missile-tracking antenna, receiver and transmitter. It focused on the missile and tracked it during its flight and firing. Both TTR and MTR controls were located in the Radar Control Trailer.

The ACQR and TTR fed position data to a computer in the Battery Control Trailer. The computer then tracked the position of the incoming target and the missile and guided the missile to an intersecting coordinate. "At the optimum time, the computer issued a burst order which detonated the ... warheads simultaneously, destroying the target. [80]

A final component in the radar technology was the Radar Collimation Mast Assembly. The 60-foot mast was used for adjusting the radar line-of-site for MTR and TTR. [81]

The following are the operations of a NIKE installation:

Taken from "Procedures and Drills for the NIKE Ajax System Field Manual 44-80," 1956.

Battery Control Area

1. ACQR: This radar, composed of the acquisition antenna, receiver, and transmitter, was used to detect, observe, identify, and designate selected targets. Operator controls and displays were located in the battery control trailer.

2. TTR: This radar was composed of the tracking antenna, receiver, and transmitter, mounted on a drop-bed antenna trailer. The three operator's controls and displays (azimuth, elevation, and range) were located on the target console in the radar control trailer. The TTR tracked the designated target and furnished target present position data to the computer.

3. MTR: This radar was composed of the missile-tracking antenna, receiver, and transmitter, mounted on a drop-bed antenna trailer. The operator's controls and displays were located on the missile console in the radar control trailer. The MTR tracked the missile, supplied the computer with missile present position data, and provided a communication link for transmitting orders from the computer to the missile. the MTR was similar in appearance to the TTR.

4. Battery Control Trailer: The battery control trailer contained the acquisition radar cabinet assembly, the battery control console assembly, the computer assembly, an early warning plotting board, and an event recorder and switchboard cabinet assembly. The battery control console assembly contained the displays and controls required by the acquisition radar operator, the battery control officer, and the computer operator.

5. Radar Control Trailer: The radar control trailer contained the target console assembly, the missile console assembly, the radar power cabinet assembly, and the radar range and receiver cabinet assembly. The missile and target consoles contained the controls and displays required for the MTR and TTR operators.

6. Radar Collimation Mast Assembly: This assembly was composed of the radar frequency test set, the radar collimation mast, and the target-head assembly. It was used in collimating, testing, and adjusting the MTR and TTR.

7. Electrical Generating Equipment: This equipment produced the necessary electrical power to operate the equipment in the fire control area. Commercial power with electrical converters to change 60-cycle power to 400-cycle power was utilized where available.

8. Battery Control Area Cable System: This cable system interconnects the various elements in the battery control area.

9. <u>Interarea Cable System</u>: The interarea cable system included the cables necessary to connect the battery control area with the launching area. When cable installation and easement costs for the interarea cable were excessive, wire and radio voice control were used.

10. <u>Maintenance and Spares Trailer</u>: This trailer provided facilities for storing portable test equipment, spare components, and spare parts. Components of the ACQR were carried in this trailer during march order.

<u>Launching Area</u>

1. <u>Launching Control Trailer</u>: The launching control trailer contained the launching control panel, the launching control switchboard, and the test responder. The launching control panel contained the controls, displays, and communications equipment necessary to supervise and monitor the activities of the launching sections during an engagement and to act as a relay station between the launching sections and the battery control area.

2. <u>Launching Section Control Cabinet</u>: This cabinet, located underground in the underground magazine storage-type sites or in the launching section revetment in aboveground installations, contained the necessary controls, indicators, and communication facilities to enable a launching section to control the preparation and firing of its rounds. It also coordinated the activities of the launching section with the launching control panel operator in the launching control trailer. It consisted of a launching section control panel and a launching section power cabinet.

3. <u>Launcher-Loader Assemblies</u>: The launcher-loaders provided the equipment necessary to accomplish the physical operations at the launching site for storing, loading, and firing the rounds.

4. <u>Electrical Generating Equipment</u>:

    a. <u>Aboveground sites</u> -- electric power for aboveground sites was supplied by 400-cycle, 30-kilowatt (kw) engine generators, or by commercial sources with suitable converters when available.

    b. <u>Underground sites</u> -- electric power for underground sites is supplied by 150-kw, 60-cycle diesel generators or by commercial sources, when available. Direct 60-cycle power was used for the elevator. Where 400-cycle power was required, the 60-cycle power was converted to 400-cycle power by means of frequency converters.

5. <u>Launching Area Cable System</u>: This system interconnects the various elements of the launching area.

Hercules Operation

The Hercules was designed specifically so that it could be launched from Ajax equipment, although the storage racks and elevators were modified because Hercules rockets were longer. The new missiles also used Ajax radar, but some Hercules sites were equipped with HIPAR, High-Power Acquisition Radar, which was necessary due to the increased range and altitude of Hercules. [82]

HISTORY OF NEW ENGLAND AND PROVIDENCE DEFENSE BATTERIES

New England Defense

> In the new age of long-range aircraft and missiles, New England was of prime strategic importance. Its harbor, naval stations, industries, and centers of dense population had in the past merited the heaviest concentration of coastal fortifications in the country. Now a new strategic element was added. Air attacks and retaliations, if they should come, would be made over the Arctic Circle, which pinpointed New England as a key area for measures both of defense and offense. [83]

Continuing a tradition of coastal defense dating back to the eighteenth century, many types of Cold War fortifications were constructed in the Northeast. In addition to building NIKE sites in New England, Cold War construction resulted in a score of Air Force installations as well as aircraft warning stations. Loring AFB in Limestone, ME, completed in 1950, was among the first Strategic Air Command (SAC) bases constructed in New England. In Bangor, ME, Dow AFB was built in the early 1950s as was Pease AFB in Portsmouth, NH, completed in 1954. Otis AFB, near Falmouth, MA, Hanscom Field in Bedford, MA, and Ethan Allen Field in Burlington, VT, were all major installations of the Air Defense Command. [84]

Aircraft warning stations within New England were spread from Cape Cod to northern Vermont with stations at Charleston, Bucks Harbor, and Caswell, ME and at North Concord, VT. Scattered throughout these stations were small remote-controlled installations consisting of a radar tower and small cement equipment building, "positioned so as to detect planes that might penetrate under the radar sweeps of the main stations by coming in low from the sea or along major river valleys." [85]

Also constructed during this period were emplacements for radar-controlled 75-millimeter antiaircraft batteries near Loring and Dow AFBs, and in a ring around Boston from Lynn in the north to Hull in the south. [86]

From 1955 through 1957, 35 NIKE installations were completed throughout New England: 4 in Maine, 14 in Massachusetts, 12 in Connecticut and 5 in Rhode Island. These sites protected Loring AFB, ME; Boston, MA; Bridgeport and Hartford, CT; and Providence, RI. [87]

Initially, all batteries throughout New England were supplied with Ajax missiles. When the Hercules missile was developed, it was placed in selected batteries around Boston, Bridgeport, Hartford, Providence and Loring. [88]

Providence Defense

Much of the following information is taken from drawings on microfiche in the Real Estate Office of the COE, Waltham, MA.

Rhode Island's five batteries were located in Coventry PR-69, which was the headquarters site, North Kingston PR-58, North Smithfield PR-99, Foster PR-79 and Bristol PR-38, forming an arc around Providence. The Providence Defense Area also included NIKE Battery PR-29, which was located in Swansea and Dighton, Massachusetts and PR-19 in Rehoboth, Massachusetts. Providence Defense Area was under the 68th Artillery/4th Battalion Command which was part of the 751st Battalion. Coventry NIKE Battery PR-69 was the 4th Battalion Headquarters of which Foster PR-79 was Battery D of the 4th Battalion, 68th Artillery.

Only two sheets of drawings have been found, so far, for PR-79. These are paving plans, generated by Green Engineering Affiliates, Inc., Boston, MA, in 1957. They clearly show the Launch and Control Areas and it is from these, and additional information, that site changes have been documented. Drawings generated for PR-38, Bristol, Rhode Island, are, according to Index of Microfiche at the COE, Waltham, MA, the standard drawings for PR-79.

Documentation concerning specific construction activities relating to the Providence batteries is spotty, but there is enough information to provide some construction history of the Rhode Island sites.

Although the Providence Defense Area consisted of six individual sites, much of the design and site work was done by one or two contractors for all of the sites. Site specifics were different, but general layouts were similar. For example, PR-58 appears to have had only an Administration Building, in addition to all radar facilities, at the site, thereby indicating that Barracks and Mess Hall were probably located at the Launch Area. PR-99 was laid out in a similar plan to that of PR-79, with buildings in a U-shape and all radar equipment north of the structures.

In 1955, North Smithfield PR-99's general plan and a layout for both Launch and Control areas were completed by the Crandall Engineering Company. The following year, Fay, Spofford and Thorndike, Boston architects and engineers, designed the layout for both the Launch and Control sites for North Kingston PR-58. Grading, layout and utility plans for the Interconnecting Corridor for all five sites were completed by Fay, Spofford and Thorndike in 1956. In 1957, a layout and a general plan were designed for PR-38 in Bristol. The same year, a paving plan showing existing conditions was produced for PR-79 by the Crandall

Engineering Company, indicating that Foster was virtually completed by this time. PR-69, Coventry, was laid out between 1955 and 1957 and because it was the Battalion Headquarters of Providence Defense, it contained additional buildings to house commanding staff and officers.

From 1959 through 1960, PR-38 and PR-99 were converted to Hercules missiles, with PR-38 receiving High-Powered Acquisition Radar (HIPAR). These were the only batteries in the Providence Defense Area to receive Hercules missiles. [89] Retrofitting entailed upgrading construction of a Warheading Building, modifying the Underground Missile Storage structure, adding fallout shelters, and modifying existing radar. Since Hercules missiles were longer and wider than Ajax missiles, changes to Underground Missile Storage involved new storage and launching racks, modification of guides and hatches, and the extension of elevator platforms.

Leon Chatelain and Spector and Montgomery provided standard drawings for the conversion of Underground Missile Storage structures. It is presumed that one or the other provided drawings for the Warheading Building as well. James Farina Corporation, of Newton, MA, was authorized by the Corps' Providence, RI, office to build Warheading Buildings in the Boston and Providence Defense Area. [90]

Fay, Spofford and Thorndike was founded in 1914 in Boston and is still actively engaged in architecture and engineering. Over the past 78 years, it has been involved in over 12,000 projects, many of which were and are in New England. They have been doing military work since their inception. [91] To date, no information on the other construction contractors has been found.

Seventy-six units of housing were constructed for families of married officers at Providence Defense Area sites. Those for Providence Defense Area were single-story, detached, with two and three bedrooms, depending on whether the housing was for an NCO or Grade Officer. [92]

The Foster site, PR-79, was the first of the Providence Defense Area to be decommissioned. In 1974, Bristol PR-38 was also decommissioned and is unused at present. North Kingston PR-58, although decommissioned, was located on an Army Post, and is still Army property and used for military activities. PR-69 in Coventry was taken and retained by the Army National Guard until 1981, when it was excessed by the Town. The launch silos have been demolished and the site is part of the town's Parks and Recreation facilities. No information is available concerning the North Smithfield site.

PR-79 Missile Battery

The Foster NIKE Missile Battery PR-79 is located approximately 15 miles west of Providence off State Highway 101. In a rural region, both locales (Launch and Control Areas) are surrounded by second-growth forest of deciduous and evergreen trees. The Launch Area, on East Windsor Road, is on the top of a hill and just east of Rhode Island's highest elevation of 812 feet. The Control Area, on Tucker Hollow Road, is located at the top of Oak Hill, less than a mile across a small valley from the Launch Area. Sixteen units of Capehart housing are located on Boss Road, about one-half mile north of the Launch Area. The Launch and Control areas are accessible from State Highway 101 and are, by automobile, about 8-10 minutes apart. Both were laid out according to the recommended guidelines of the COE, with slight variations due to local conditions.

On October 31, 1955, the United States government took seven tracts of land with a total of 59.7 acres, owned by five owners, through a condemnation authorized by Congress. The land was acquired for $3,100.00 [93] and was used for the Launch Area, Control Area, fire protection and security barrier, and line-of-sight between the two areas. There are several restrictions in the deed including "the right to prohibit gatherings of more than twenty-five (25) people" on the land, removal of existing roads, "the right to trim, cut, fell and remove there from [sic] all trees, underbrush and obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way" and the "right to remove, raze or destroy those portions of buildings, other structures, and land infringing upon or extending into or above the line-of-sight clearance." [94] Two lines-of-sight were described. The first was a triangular plane surface connecting the Battery Control Site and the Battery Launching Site. The other was a rectangular plane 20 feet in width connecting the two sites. Sometime before 1958, an additional 10.21 acres was taken, some of which was used for Capehart housing. Much of the land was farm land or orchard. [95]

In 1964, the Launch and Control Areas were declared excess by the General Services Administration (GSA). The Launch Area was turned over to the Rhode Island State Police in 1965 and the Control Area to the Foster School District. Capehart housing was declared excess by the GSA in 1968 and sold in 1970 to Coffey and Teachout of Burlington, VT, who developed the site into private housing. [96]

SIGNIFICANCE

The Foster NIKE Battery PR-79 is significant because it is a representative example of NIKE batteries in New England and Rhode Island. PR-79 is an intact, physical manifestation of American military history and, in particular, of the Cold War in the United States. As such, it demonstrates the technology and prevailing political attitudes of the 1950s.

PR-79 is in a remarkable state of preservation, which is due in part to the fact that the Launch Area was taken over by the Rhode Island State Police, a military-like organization. The State Police have carefully maintained the site and have made few changes, thus, keeping the military/security feel to the area. Even spaces around the missile-storage structures, despite their current state of disuse, are regularly mowed and cleared of any debris. Their visual impact has been maintained and they can be understood despite the removal of the missiles themselves.

The construction of the firing range sometime after 1964 involved removing a large earthen berm and possibly fueling structures; this disturbance has compromised the integrity of this area, since the Acid Fueling Station was a critical component of the NIKE procedure. Overall, however, the site maintains a high degree of integrity.

The Control Area has undergone very few changes and is an excellent example of a 1950s NIKE site, as well. While it has not been as meticulously maintained as the Launch Area, the plan and intent of the original scheme are readily evident. However, the Control Area has suffered a loss of integrity as a result of the removal of radar equipment and vans when the site was decommissioned. There is little evidence of the historical activities that took place there, but this would be true of most decommissioned NIKE sites.

In its entirety, PR-79 is a significant example of an intact NIKE site and, with the addition of documentary evidence, provides a complete representation of a NIKE installation of the 1950s.

ENDNOTES

1. Kenneth Gatland, Missiles and Rockets, (New York: Macmillian Publishing Company, Inc.), p. 9.

2. Gatland, Missiles and Rockets, pp. 9,11.

3. Bill Gunston, Illustrated Encyclopedia of the World's Rockets and Missiles, (London: Salamender Books), pp. 8-9.

4. Roger Hatheway et al., Survey and Evaluation of the Nike Missile Site at Fort MacArthur, White Point Los Angeles County, California, (San Diego, CA), p. 9.

5. John Lewis Gaddis, The United States and the Origins of the Cold War, 1941-1947, (New York: Columbia University Press), p. 72.

6. B. N. McMaster, et al, Historical Overview of the Nike Missile System, (Gainesville, FL), p. 2-1.

7. Gunston, Illustrated Encyclopedia of the World's Rockets and Missiles, pp. 171-172.

8. McMaster, et al, Historical Overview of the Nike Missile System, pp. 2-4,2-5.

9. Gunston, Illustrated Encyclopedia of the World's Rockets and Missiles, p. 174.

10. Aubrey Parkman, Army Engineers in New England. The Military and Civil Work of the Corps of Engineers in New England, 1775-1975, (Waltham, MA: U.S. Army Corps of Engineers), pp. 147-148,150.

11. Jane Carolan, et al, Architectural Survey, Volume I Architectural History, F.E. Warren Air Force Base, p. 3-68.

12. Ibid., p. 3-69.

13. Ibid., p. 3-68.

14. Gunston, Illustrated Encyclopedia of the World's Rockets and Missiles, p. 175.

15. Ibid., p. 177.

16. United States Congress, Office of Technology Assessment. Ballistic Missile Defense Technologies (Washington, DC: United States Government Printing Office), p. 51.

17. Ibid., p. 37.

18. Gunston, Illustrated Encyclopedia of the World's Rockets and Missiles, pp. 178-179.

19. Jane Carolan, et al, Architectural Survey, p. 3-69.

20. McMaster, et al, Historical Overview of the Nike Missile System, p. 3-1.

21. The Stackpole Company, The Army Almanac, (Harrisburg, PA), p. 84.

22. McMaster, et al, Historical Overview of the Nike Missile System, p. 3-1.

23. Ibid., pp. 3-4,4-5.

24. Bruce Jacobs, A Final Report: NIKE-Hercules Air Defense is Phased Out of the Army National Guard, (Washington, DC: Department of the Army and the Air Force, National Guard Bureau), p. 4.

25. Ibid., pp. 4,5.

26. Ibid., p. 9.

27. Ibid.

28. Parkman, Army Engineers in New England, pp. 11,133.

29. Ibid., p. 134.

30. Ibid.

31. Ibid., p. 141.

32. Fort Belvoir, VA, Office of History, United States Corp of Engineers, NIKE Microfiche, "A Short History of the Corps of Engineers Participation in the NIKE Program," Nike-Gen. History of Design 62-A-1478 (PW) Box 38, Missiles & Protective Structures Branch Engineering Division, Milcondir, OCE Central Decimal Files, Fiche 1, page 1.

33. Fort Belvoir, VA, Office of History, United States Corp of Engineers, NIKE Microfiche, "Memo, Chief Engineering Division to Chief, Structures Branch, COE." Magazines -"B" Box 2B Nike-Hercules 62-A-1478 (PW) Box 40, Missiles & Protective Structures Branch Engineering Division, Milcondir, OCE Central Decimal Files, Fiche 1.

34. Fort Belvoir, VA, "A Short History of the Corps of Engineers Participation in the NIKE Program", p. 1.

35. Fort Belvoir, VA, "Memo, Chief Engineering Division to Chief, Structures Branch, COE".

36. McMaster, et al, Historical Overview of the Nike Missile System, p. 3-2.

37. Fort Belvoir, VA, United States Army Corps of Engineers, Office of History, NIKE Microfiche, "Site Selection Criteria for Nike On-Site Program, Office of the Chief of Engineers", Nike-Gen. History of Design 62-A-1478 (PW) Box 38, Missiles & Protective Structures Branch Engineering Division, Milcondir, OCE Central Decimal Files, Fiche 2, p. 1.

38. Ibid., p. 1.

39. Ibid., p. 4.

40. Ibid.

41. Ibid., p. 8.

42. Ibid., p. 6.

43. Ibid., pp. 3, 8.

44. Ibid., p. 8.

45. Carolan, et al, Architectural Survey, p. 3-17.

46. Telephone Interview, Leon Chatelain,III, son of architect Leon Chatelain, Jr. 13 May 1993.

47. "A Short History of the Corps of Engineers Participation in the NIKE Program", p. 3.

48. Ibid., p. 2.

49. Ibid., p. 3.

50. Fort Belvoir, VA, United States Army Corps of Engineers, Office of History, NIKE Microfiche, "Memo, Chief Specifications and Estimating Branch to Chief, Engineering Division, COE", Nike-Gen. History of Design 62-A-1478 (PW) Box 38, Missiles & Protective Structures Branch Engineering Division, Milcondir, OCE Central Decimal Files, Fiche 2, p. 3.

51. Fort Belvoir, VA, United States Army Corps of Engineers, Office of History, NIKE Microfiche, "SPECIAL INSTRUCTION AND ENGINEERING DATA FOR NIKE ON-SITE PROGRAM, Office of the Chief of Engineers", Planning Nike, General 2B 62-A-1478 (PW) Box 38, Missiles & Protective Structures Branch Engineering Division, Milcondir, OCE Central Decimal Files, Fiche I, p. 3.

52. Fort Belvoir, VA, United States Army Corps of Engineers, Office of History, NIKE Microfiche, "DRAFT, GENERAL DESCRIPTION OF FACILITIES AT TYPICAL NIKE INSTALLATIONS", General 2B 62-A-1478 (PW) Box 38, Missiles & Protective Structures Branch Engineering Division, Milcondir, OCE Central Decimal Files, Fiche I, pp. 1-3.

53. Fort Belvoir, VA, "A Short History of the Corps of Engineers Participation in the NIKE Program", Insert D. Nike-Gen. History of Design 62-A-1478 (PW) Box 38, Missiles & Protective Structures Branch Engineering Division, Milcondir, OCE Central Decimal Files, Fiche 1, no page.

54. Fort Belvoir, VA, "SPECIAL INSTRUCTION AND ENGINEERING DATA FOR NIKE ON-SITE PROGRAM, Office of the Chief of Engineers", Planning Nike, General 2B 62-A-1478 (PW) Box 38, Missiles & Protective Structures Branch Engineering Division, Milcondir, OCE Central Decimal Files, Fiche I, p. I.

55. Fort Belvoir, VA, "SPECIAL INSTRUCTION AND ENGINEERING DATA FOR NIKE ON-SITE PROGRAM", p. 2.

56. Fort Belvoir, VA, "SPECIAL INSTRUCTION AND ENGINEERING DATA FOR NIKE ON-SITE PROGRAM", p. 4.

57. Fort Belvoir, VA, "SPECIAL INSTRUCTION AND ENGINEERING DATA FOR NIKE ON-SITE PROGRAM", p. 4.

58. Carlisle, PA, Institute for Military History, Carlisle Barracks, Senior Officers Oral History Program, Lt. General Robert Hackett, Retired, Project 83-C, p. 250.

59. Congressional Quarterly Service, Congress and the Nation, 1945-1964. A Review of Government and Politics in the Post War Years, (Washington, DC), p. 6a,474,497.

60. Carolan, et al, Architectural Survey, p. 3-69; Suitland, MD, National Archives, Military Records, Record Group 285/53, "Memo, Sub-Authorization-Providence Defense Area-Design and Construction of Title VIII, Capehart Housing, to Division Engineer, Boston".

61. ARADCOM Argus, Unsigned article, "Generalized Sequence of Inactivation Events for Sites", ARADCOM Argus, February 1974, p. 12.

62. McMaster, et al, Historical Overview of the Nike Missile System, p. 2-4.

63. ARADCOM Argus, Unsigned article, "Generalized Sequence of Inactivation Events, p. 12; Fort Belvoir, VA, "Letter to Senator John Stennis from Robert T. Stevens, Secretary of the Army," Nike-Gen. History of Design 62-A-1478 (PW) Box 38, Missiles & Protective Structures Branch Engineering Division, Milcondir, OCE Central Decimal Files, Fiche 3, n.p.

64. Steven Malevich, "Nike Deployment", Military History 320, p. 417.

65. McMaster, et al, Historical Overview of the Nike Missile System, p. 2-1; Macmillian Educational Corp., Merit Students Encyclopedia, Vol. 12, p. 322; Malevich,"Nike Deployment", p.417; United States Army, "Air Defense Artillery Missile Battalion-Nike Ajax. Department of the Army Field Manual 44-85," (Washington DC: Department of the Army), p. 3.

66. McMaster, et al, Historical Overview of the Nike Missile System, p. 5-1.

67. ARADCOM Argus, "Generalized Sequence of Inactivation Events, February 1974, p. 12.

68. McMaster, et al, Historical Overview of the Nike Missile System, p. 5-1; Malevich, "Nike Deployment", p. 417.

69. McMaster, et al, Historical Overview of the Nike Missile System, p. 2-2.

70. Ibid.

71. Ibid., p. 5-9.

72. ARADCOM Argus, November 1959, p. 3.

73. McMaster, et al, Historical Overview of the Nike Missile System, p. 5-14.

74. United States Army, "Technical Manual for Nike-Ajax. Department of the Army Technical Manual TM-9-500." (Washington DC: Department of the Army), no date, no page; United States Army, "Procedures and Drills for the Nike Ajax System. Department of the Army Field Manual 44-80." (Washington DC: Department of the Army), November 1956, p. 243.

75. United States Army, "Air Defense Artillery Missile Battalion -Nike Ajax. Field Manual 44-85", p. 40.

76. Ibid., p. 55.

77. Hatheway, Roger, et al, Survey and Evaluation of the Nike Missile Site at Fort MacArthur, White Point Los Angeles County, California (San Diego, CA), p. 33.

78. McMaster, et al, Historical Overview of the Nike Missile System, p. 4-4.

79. Ibid., p. 5-8.

80. Ibid., p. 5-1.

81. Ibid., p. 5-7.

82. United States Army. "Procedures and Drills for the Nike Ajax System. Department of the Army Field Manual 44-82." (Washington DC: Department of the Army), November 1968, p. 10.

83. Parkman, Army Engineers in New England, pp. 141-142.

84. Ibid., pp. 148-149.

85. Ibid., p. 150.

86. Ibid.

87. McMaster, et al, Historical Overview of the Nike Missile System, Appendix B.

88. Suitland, MD, National Archives, Military Records, Record Group 285/53, "Memo, Advise of Authorization and/or Allotment, To Division, Engineering Corps."

89. "Memo, Advice of Authorization and/or Allotment, To Division, Engineering Corps."

90. Ibid.

91. Telephone Interview, Susan Thomas, Marketing Associate, Fay Spofford & Thorndike, 13 May 1993.

92. "Memo, Advise of Authorization and/or Allotment, To Division, Engineering Corps."

93. Providence, RI, Providence County Record of Deeds, Book 29: 190-193.

94. Ibid., Book 29:191.

95. Ibid., Book 29:190-193.

96. Waltham, MA, United States Army Corps of Engineers, Real Estate Office, Realty Control File Summary.

BIBLIOGRAPHY

ARADCOM Argus.

Unsigned article. "Generalized Sequence of Inactivation Events for Sites." February 1974, page 12.

Unsigned, untitled article. November 1959:3.

Carlisle, PA, Institute for Military History, Carlisle Barracks. Senior Officers Oral History Project, Interview of Lt. General Robert Hackett, Retired, Project 83-C. 1983.

Carolan, Jane, and Bowers, Martha H. for URS-Berger, Inc. *Architectural Survey, Volume I Architectural History, F.E. Warren Air Force Base,* September 1984.

Congressional Quarterly Service. Congress and the Nation, 1945-1964. A History of Government and Politics in the Post War Years. Washington, DC, 1964.

Fort Belvoir, VA, Office of History, United States Corps of Engineers, NIKE Microfiche.

"DRAFT, GENERAL DESCRIPTION OF FACILITIES AT TYPICAL NIKE INSTALLATIONS, CA. 1957." General 2B 62-A-1478 (PW) Box 38, Missiles & Protective Structures Branch Engineering Division, Milcondir, OCE Central Decimal Files, Fiche 1.

"Letter to Senator John Stennis from Robert T. Stevens, Secretary of the Army," ca. 1954. Nike-Gen. History of Design 62-A-1478 (PW) Box 38, Missiles & Protective Structures Branch Engineering Division, Milcondir, OCE Central Decimal Files, Fiche 3.

"Memo, Chief Engineering Division to Chief, Structures Branch, COE, 13 July 1953." Magazines -"B" Box 2B Nike-Hercules 62-A-1478 (PW) Box 40, Missiles & Protective Structures Branch Engineering Division, Milcondir, OCE Central Decimal Files, Fiche 1.

"Memo, Chief Specifications and Estimating Branch to Chief, Engineering Division, COE, 10 May 1955." Nike-Gen. History of Design 62-A-1478 (PW) Box 38, Missiles & Protective Structures Branch Engineering Division, Milcondir, OCE Central Decimal Files, Fiche 2.

"A Short History of the Corps of Engineers Participation in the NIKE Program, ca. 1957." Nike-Gen. History of Design 62-A-1478 (PW) Box 38, Missiles and Protective Structures Branch Engineering Division, Milcondir, OCE Central Decimal Files, Fiche 1.

"A Short History of the Corps of Engineers Participation in the NIKE Program, ca. 1957, Insert D." Nike-Gen. History of Design 62-A-1478 (PW) Box 38, Missiles & Protective Structures Branch Engineering Division, Milcondir, OCE Central Decimal Files, Fiche 1.

"Site Selection Criteria for Nike On-Site Program, Office of the Chief of Engineers, J July 1954." Nike-Gen. History of Design 62-A-1478 (PW) Box 38, Missiles & Protective Structures Branch Engineering Division, Milcondir, OCE Central Decimal Files, Fiche 2.

"SPECIAL INSTRUCTION AND ENGINEERING DATA FOR NIKE ON-SITE PROGRAM, Office of the Chief of Engineers, 7 April 1954." Planning Nike, General 2B 62-A-1478 (PW) Box 38, Missiles & Protective Structures Branch Engineering Division, Milcondir, OCE Central Decimal Files, Fiche 1.

Gaddis, John Lewis. *The United States and the Origins of the Cold War*, 1941-1947. New York: Columbia University Press, 1972.

Gatland, Kenneth. *Missiles and Rockets*. New York: Macmillan Publishing Co., Inc., 1975.

Gunston, Bill. *Illustrated Encyclopedia of the Worlds Rockets and Missiles*. London: Salamender Books, 1979.

Hatheway, Roger; Van Wormer, Stephen; and Schilz, Allan, J. for Westec Services, Inc. *Survey and Evaluation of the Nike Missile Site at Fort MacArthur, White Point Los Angeles County, California.* Prepared for the United States Army Corps of Engineers, Los Angeles District. San Diego, CA, February 1987.

Jacobs, Bruce. *A Final Report: NIKE-Hercules Air Defense is Phased Out of the Army National Guard.* Washington, DC: Department of the Army and the Air Force, National Guard Bureau, 1985.

Macmillan Educational Corporation. *Merit Students Encyclopedia*, Vol. 12:322, New York:1975.

Malevich, Steven. "Nike Deployment." *Military History* 320:416-420.

McMaster, B.N.; Sosebee, J.B.; Fraser, W.G.; Covro, K.C.; Jones, C.F.; Grainger, S.A.; and Civitarese, K.A. for Environmental Science and Engineering, Inc. *Historical Overview of the Nike Missile System*. Prepared for the United States Army Toxic and Hazardous Materials Agency, Assessment Division, Aberdeen Proving Ground, MD. Gainesville, FL, December 1984.

Parkman, Aubrey. *Army Engineers in New England: The Military and Civil Work of the Corps of Engineers in New England, 1775-1975.* Waltham, MA: United States Army Corps of Engineers, New England Division, 1978.

Providence, RI, Providence County Record of Deeds. Book 29:190-193.

Stackpole Company. *The Army Almanac. A Book of Facts Concerning the United States Army.* Harrisburg, PA, 1959.

Suitland, Maryland , National Archives, Military Records. Record Group 285/53.

"Abstract of Bid-Construction, 25 February 1959."

"Memo, Advice of Authorization and/or Allotment, To Division, Engineering Corps."

"Memo, Sub-Authorization - Providence Defense Area - Design and Engineering Corps 30 March 1959. Construction of Title VIII, Capehart Housing, 12 March 1956, to Division Engineer, Boston."

United States Army. "Air Defense Artillery Missile Battalion-Nike Ajax. Department of the Army Field Manual 44-85." Washington DC: Department of the Army, July 1959.

United States Army. "Procedures and Drills for the Nike Ajax System. Department of the Army Field Manual 44-80." Washington DC: Department of the Army, January 1956, November 1956, July 1959.

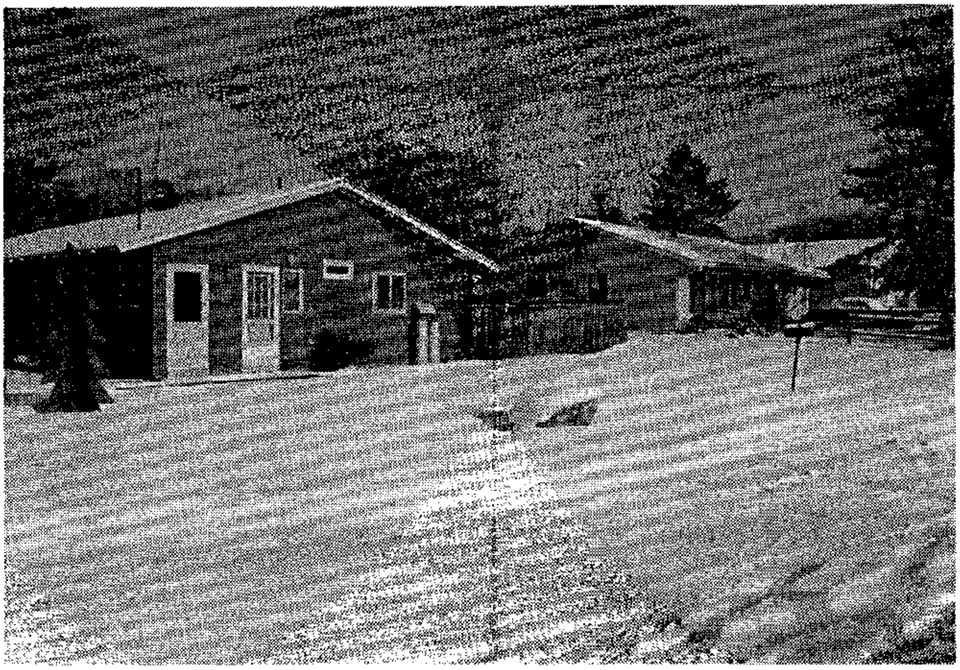
United States Army. "Technical Manual for Nike Ajax." Department of the Army Technical Manual 9-500." Washington DC: Department of the Army, no date.

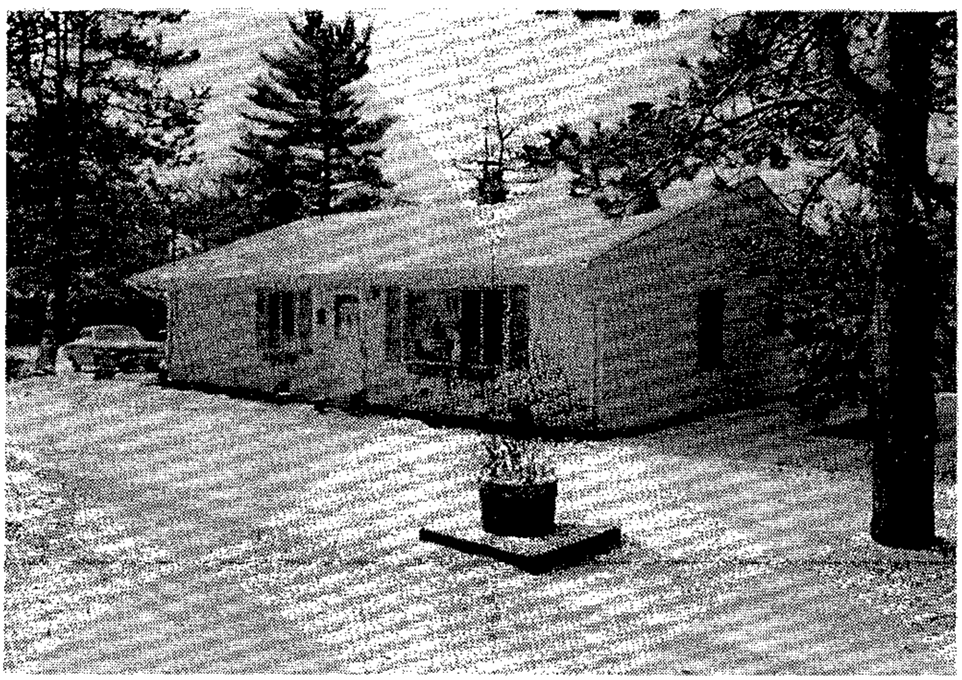
United States Army. "Procedures and Drills for Nike-Hercules Missile Battery. Department of the Army Field Manual 44-82." Washington DC: Department of the Army, July 1959.

United States Congress, Office of Technology Assessment. Ballistic Missile Defense Technologies. Washington, DC: United States Government Printing Office, 1985.

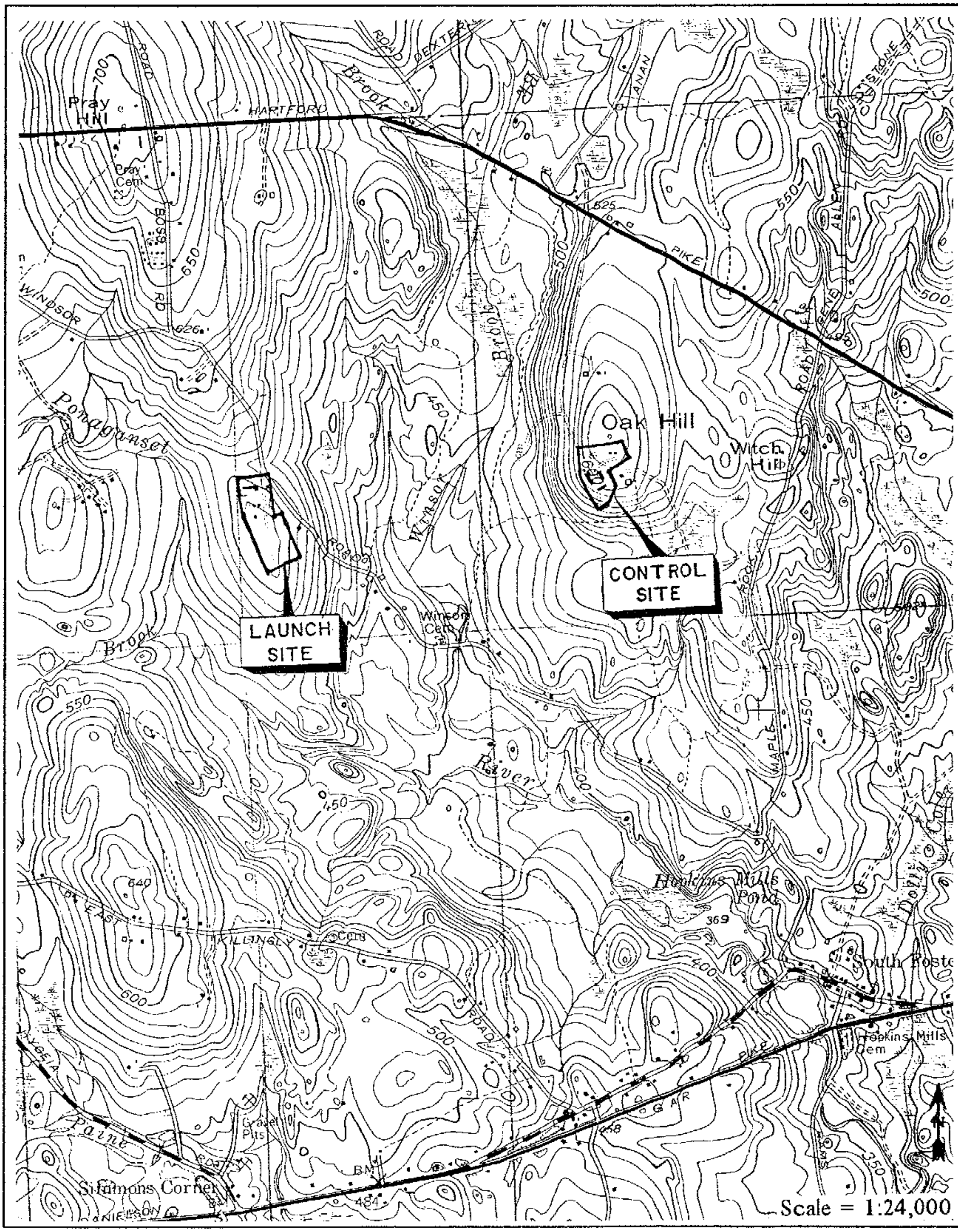
Waltham, MA, United States Army Corps of Engineers, Real Estate Office.

Drawings of standard buildings and individual installations. On Microfiche.
Realty Control File Summary, 1968, 1974.





Figures 1 & 2 - Capehart Housing, PR-79, East Windsor Road, Foster, RI, November, 1991.



Topographic map showing location of Launch Area and Control Area.